

Eco Char	Vital Sign Category	Monitoring Objectives	VS Id#	Vital Sign	Monitoring Question(s)	Monitoring Method	Metrics	Vital Sign Rank (0-5)	Comments / Notes
Human activities & cultural practices	Park Use & Activities	Monitor levels of take & harvest of harvested species (marine, freshwater, and terrestrial) or resources (coral, sand)	H15	Reef Fisheries Harvest	Are harvest levels changing? What are trends? Is human harvest changing distribution, abundance, or other population characteristics? Harvest includes legal and illegal take.	Systematic monitoring of fishing and harvest of shellfish and other inverts in coastal areas; population characteristics of target species	catch per unit effort, collection statistics (quantity, age/size), composition, Creel counts, harvest quantity	2.6	
		Monitor community dynamics, structure, function, and composition	M13	Water Column Marine Vertebrates and Invertebrates Biodiversity	Are there long-term changes (community composition, distribution) in selected native communities?	telemetry, quadrats, transects, aerial surveys, tows, traps	Relative abundance, demographics, distribution, movement, diversity	2.8	
	Marine Ecosystems	Track community and population trends in harvested fisheries species	M14	Water Column Reef Fisheries	Is variation in community / population parameters due to harvest? What are effects of human harvest on fished or gathered species?	Transects, quadrat	Abundance, demography, size class, recruitment	2.2	
		Monitor disease incidence and impacts, especially on native species	M15	Established Marine Animal (other than turtles) Disease & Pathogens	What is the incidence and level of disease in populations? Are diseases/pathogens affecting populations? What are trends in disease/pathogen?	Incidence, telemetry	disease types, occurrence, tissue samples, vectors	1.9	
		Monitor extent and response to treatment of established invasive species	M17	Established Alien Species - Water Column Marine	Can we detect changing trends in alien and invasive species? What are effects of alien and invasive species on communities? What is response to treatment?	Transects, quadrats	abundance, demography, distribution	2.5	
		Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species	M18	Water Column Marine Invertebrates	Is variation within normal range? What are temporal trends?	Transects, quadrats, tows, traps	Abundance, size, demography, recruitment rates	2.8	
			M19	Fish Growth/Size and Age Structure, and Recruitment	Is variation within normal range? What are selected short- and long-term trends?	transects, quadrats, photoquadrats, mapping	abundance of size classes, recruitment rates, species diversity	3.2	
			M20	Marine Species Protection (T, E, S-o-C species)	Is variation within normal range? What are temporal trends?	telemetry, quadrats, transects, aerial surveys	abundance, demographics, distribution, movement	3.3	
		Monitor occurrence of non-established (incipient) invasive species	M21	Alien Incipient Invasives - Water Column Marine	Is species present, if so what is the nature and extent of infestation? What are the most effective strategies for detecting and preventing new invasives species? Where should efforts be focused? What are potential impacts?	Transects, quadrats, tows, traps	abundance, demography, distribution	2.1	
	Intertidal Population	Track community and population trends in harvested fisheries collected species	M25	Intertidal Reef Fisheries / Collected species (limu, opih, crabs, fish, etc.)	What are effects of human harvest on fished or gathered species? What are trends in harvested species?	Transects, quadrats, mapping, traps, biomass, percent cover	Demographics, size, recruitment, distribution	2.3	

Intro, Monitoring goals & objectives, Conceptual Models, and Vital Signs

Also use main handout of review materials (http://www.nature.nps.gov/im/units/pacn/monitoring/plan/vs04/review_materials.htm)

Ecological Characteristic	Vital Sign Category		Monitoring Objectives
Human activities & cultural practices	Soundscapes		Monitor sound sources, frequencies, occurrence, and levels
	Viewscapes / Lightscapes		Monitor landscape / seascape appearance Monitor light levels and characteristics of light/dark cycles
	Land Use		Monitor points of entry for invasive species Monitor water use adjacent to or upstream from park boundaries Monitor land use adjacent to, or upstream of, park boundaries
	Park Use & Activities		Monitor debris-trash occurrence in coastal, riparian, wetland, and lacustrine habitats; in or near high use areas Monitor patterns of park visitation, use & damage (terrestrial & marine) Monitor incidence & occurrence of bioprospecting
	Management Zones		Monitor levels of take & harvest of harvested species (marine, freshwater, and terrestrial) or resources (coral, sand) Monitor patterns and effects of use and management Monitor effects of management practices on wilderness character
	Climate & Air Quality		Monitor visibility Track rates of atmospheric deposition Track atmospheric concentrations of particulates and gases, levels of radiation--emphasizing those with known human health or environmental impacts Monitor core weather/climate conditions within each park (on each island) Monitor frequency and intensity (severity) of extreme events (hurricanes, waves, winds, rain, etc.) Identify and monitor spatial patterns of climate, such as trade-wind inversion elevation, lifting condensation level, lapse rates, etc.
			Monitor physical ocean dynamics--ocean currents, sea level, tides/swell Monitor cycles of nutrients and elements within soils and water--including carbonate (oceanic), nitrogen, and phosphorous
			Monitor soil erosion Monitor soil quality trends (physical, toxics/contaminants, other biologic and nutrients) Monitor condition and extent of soil crusts Monitor trends in surface water flow regimes Monitor wetland (incl. anchialine ponds) water flow exchange dynamics, size, and distribution Monitor ground water flow rates and direction of movement (recharge)
			Monitor water quality core parameters Monitor supplemental water quality parameters Monitor microbiological water quality parameters Monitor toxic and contaminant levels in water Monitor biological invertebrate communities
			Monitor surface volcanic activity (lava flows, eruption events & ground deformation) Monitor volcanic & non-volcanic seismicity Monitor extent, location, and causes of mass wasting events (e.g. landslides)
			Monitor shoreline dynamics Track dune locations and topography Identify and monitor the extent of permafrost Monitor karst and non-karst cave and lava tube habitat characteristics, topography, and extent
Physical / Chemical Environment	Terrestrial Ecosystems	Vegetation	Monitor patterns of distribution & extent of community types Monitor fire regimes and effect on vegetation Track insect and disease presence during forest dieback
			Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
		Consumers	Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
			Cave Systems Community Monitor changes in cave communities
		Freshwater Ecosystems	Producers Monitor community composition, structure, and productivity
			Community Monitor community dynamics, structure, function, and composition
			Monitor disease incidence and impacts, especially on native species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
			Community Monitor community dynamics, structure, function, and composition
Biotic Integrity	Marine Ecosystems	Benthic	Landscape Monitor patterns of distribution & extent of community types
			Community Monitor community dynamics, structure, function, and composition
			Population Track community and population trends in harvested fisheries / collected species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
		Water column (motile)	Community Monitor community dynamics, structure, function, and composition
			Track community and population trends in harvested fisheries species Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor occurrence of non-established (incipient) invasive species
		Intertidal	Community Monitor community dynamics, structure, function, and composition
			Track community and population trends in harvested fisheries collected species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor extent and response to treatment of established invasive species
			Monitor occurrence of non-established (incipient) invasive species